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NEW DRUGS AND HEALTH TECHNOLOGIES FOR LOW INCOME POPULATIONS: WILL THE PRIVATE SECTOR MEET THE NEEDS OF LOW INCOME POPULATIONS IN DEVELOPING COUNTRIES?

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New drugs and health technologies for low income populations: Will the private sector meet the needs of low income populations in developing countries?

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Abstract

This paper argues that the development of targeted technologies for poor people will require a new mix of technology, organisations and institutions. Using a technology-market matrix we explore new social technologies which may sometimes include MNCs but are also associated with developing country private sector firms and not for profit Product Development Partnerships (PDPs). The paper argues that these arrangements are most likely to generate and deliver new physical technologies and innovations processes required by low income users.

1. Introduction

Recent studies by the Global Forum for Health Research demonstrate that health research applied to the needs of low- and middle-income countries remains grossly under resourced in many areas. The term "10/90 gap[1]", while not representing an accurate current quantitative measure, has become a symbol of the continuing mismatch between needs and investments. Between 1974 and 2004 only 1.3% of the 1,556 new drugs approved by the FDA were for tropical diseases (Frew et al., 2009). More actors are now engaged in funding and conducting health research relevant to the needs of low- and middle-income country populations. However less than US $3 billion was spent on neglected diseases in 2008. Moreover, nearly 80% of current expenditure on neglected diseases went to 'big three' diseases: HIV, malaria and TB. An expanded list of remaining neglected diseases received less than 5% of global funding (Frew et al., 2009). Whilst investment in neglected diseases and addressing the healthcare priorities of low income users has improved, there is still a long way to go before the health needs of poor people are addressed. The question is how will poor people's health needs be met? Will, as C.K. Prahalad (2005) suggests in his book *The Bottom of the Pyramid,* large western MNCs awaken to the possibilities of low income markets and begin to put their considerable R&D resources in their direction? Is this possible in the context of a research intensive sector? Or is it more likely that solutions might emerge as a result of R&D investments of companies in emerging economies such as India, China, South Africa and Brazil. Or are the likely originators of new technologies the complex emergent networks forming around the current generation of public private partnerships (PPPs) and, within that category particularly, product development partnerships (PDPs)? This paper discusses these different approaches and their role in generating and delivering new 'physical technologies'[2] and innovation processes needed by low income users.

It is clear that large pharma and emerging country pharma do play an increasingly important role as purely private sector actors in serving the new science and technology based needs of higher income

[1] Only 10% of global health research investment is directed towards 90% of global disease burden (Drugs for Neglected Diseases Working Group, 2001)

[2] The distinction between physical and social technologies is explained later in the paper.

populations in developing countries. For example a number of large pharma firms have established R&D facilities in developing countries while firms from emerging countries have recently begun to seriously engage in new drug R&D. However, in the case of emerging country firms the regulatory context and the cost of getting potential drugs through clinical trials makes it very difficult for firms to target anything other than 'diseases of the rich' which afflict the wealthiest of the world's population. Analysis of Indian firms' R&D pipeline shows that their new drug development efforts are focused on chronic diseases, targeting Western and wealthier emerging markets than developing country needs (Simonetti et al., 2007). Therefore it is evident that meeting the needs of lower income populations is a bigger and more complex challenge.

In this his paper we use a Technology-Market Matrix to explore where private firms are most likely to contribute to meeting needs in developing countries and where not for profit Product Development Partnerships (PDPs) and other new 'social technologies' are more likely to meet unmet needs. These initiatives are often below the radar of the core business models of private sector firms particularly in the case of large pharmaceutical firms. Below the Radar Innovation (BRI) is a term used to describe this innovation which may not be in the sites or capacities of most large Western MNCs and which may be hard to detect with traditional indicators of R&D but which may prove vital to low income users and could potentially be disruptive to mainstream innovators (Kaplinsky et al., 2009).

This paper concludes that these new social technologies may constitute the basis of new production and innovation systems which could better serve the needs of low income populations. Additionally it makes the point that large pharmaceutical firms and firms in emerging economies which are engaging seriously in drug priorities and agendas for low income users are predominantly doing so by engaging with these new social technologies rather than changing their business models to target these users and customers using their own resources alone.

This paper is structured as follows. The second section describes a transition of firms towards more user driven styles of innovation which has occurred in wealthier countries and which has benefited rich and poor consumers in industrially advanced countries but has further marginalised users in developing countries. This section considers the value chain 'lock-in' that results from this more demand led model and introduces the concept of social technologies. The third section considers whether pharmaceuticals and the health sector are a case apart and argues that although science and technology push factors are crucial in this area, the extent to which developments are demand and policy driven are often underestimated. The emergence of the Indian pharmaceutical sector is used to clarify this argument. The fourth section makes the case that new social technologies as well as finance are necessary for innovation oriented towards low income users. This presents a Technology/Market matrix used for exploring potential solutions for unmet healthcare needs of poor populations. Building on that the fifth section addresses directly the question of whether large pharma MNCs or emerging country firms might meet the technological health needs of the poor. The sixth section details cases of two PDPs and argues that PPPs and new product development partnerships (PDPs) which are a form of not for profit PPPs might play a key role in doing this. Section seven concludes the paper.

2. From Fordism to Post-Fordism: Choice and flexibility for the world's wealthy

The last 30 years have witnessed significant changes in the organisation of industrial enterprise and production. The shift from Fordism to Post-Fordism (Jessop, 1994) has involved greater responsiveness amongst producers and new capabilities allowing for 'just-in' time production. Linear production models where discrete tasks were sequentially organised across many areas of manufacturing have been replaced by interdisciplinary teams who feed customer feedback back into the production process (Chataway et al, 2009).

This change has delivered enormous benefits to consumers in Western countries. However, as Christensen (1997) has pointed out whilst this produces efficiency and increased focus on users in many

respects it also leaves firms vulnerable to disruption from new technologies; firms become so involved in their own processes, products and customers that they are blind to challenges which appear to come from 'left field'.

Another way of thinking about firms' blind spots' is from the perspective of path dependency (Chataway et al., 2004). Firms and the value chains associated with them become entrenched and this impact on the strategies they pursue. Whilst Neo-classical economics posits that knowledge is limitless the resource based perspective holds that knowledge is 'boundaried' and firms are heavily influenced in future activities by their existing stock of knowledge resource and capabilities and the trajectories they have pursued in the past (Cohen and Levinthal,1990).

At a very general level, these dynamics have impacted upon developing countries in two principle ways. The first is simply by omission; most large MNCs and companies based in industrialised developed country contexts are not interested in the large low income market that exists in developing countries. This is the basis of Prahalad's analysis resulting in his book *The Bottom of the Pyramid* (Prahalad and Hammond, 2002). Companies have based their processes and products on serving the needs of higher income populations in developed countries. Whilst the origins of modern technologies (e.g. netbook computers) are in products have occurred first in products designed for poorer populations. However, the continuous development and feedback mechanisms have rarely led to ongoing product development which could serve and benefit those in developing countries on low incomes. More often than not business models have been based on the sustained improvements derived from continued response to evolving from market demand from consumers in wealthier contexts. The continued evolution of technologies in response to changing market and demand patterns largely does not seem to take root in products developed for poorer consumers.

Second or perhaps simply another way of seeing this is that firms producing for and serving a particular set of users create 'social technologies' around those users. Richard Nelson defines social technologies by using an analogy to the limitations of written recipes for food preparation:

…a recipe characterisation of what needs to be done represses the fact that many economic activities involve multiple actors, and require some kind of a coordinating mechanism to assure that the various aspects of the recipe are performed in the relationships to each other needed to make the recipe work. The standard notion of a recipe is mute about how this is to be done…. [We] propose that it might be useful to call the recipe aspect of an activity its "physical" technology, and the way work is divided and coordinated its "social" technology (Nelson, 2008:11).

Nelson sees the evolution of innovation as the interaction between social technologies, physical technologies and general institutions.

In relation to health innovation the concept of social technologies is particularly useful because the notion of social technologies moves us beyond thinking about the development of technologies and products as input components of health systems and apparent market failures. It emphasizes the need to look at efforts to improve healthcare through organisational and institutional innovation more widely throughout the healthcare and innovation systems.

Not all firms and initiatives will have identical social technologies and there will be a wide range of ways in which work is divided within organisations and between organisations and institutions. Often social technologies occur in a latent/implicit manner that future ensures 'lock in' or path dependency activities towards traditional markets, users and consumers. In the case of large pharmaceutical firms most if not all have as their core users relatively wealthy patients predominantly in industrially developed countries. Their social technologies are anchored in this user base.

3. The pharmaceuticals and health technologies: Science and technology driven or subject to many influences?

For some the argument that pharmaceuticals and health technologies sectors fit into the above characterisation will be controversial. Pharmaceuticals in particular are often thought of as being supply driven to a much greater degree than other manufacturing sectors. There is significantly higher spending on R&D than in many other sectors and the progression of science and basic technologies impacts in fundamental ways on the evolution of products and processes in the sector (Henderson and Cockburn, 1996) .

To some degree this is obviously the case. Yet, the extent to which the sector is influenced by factors others than science and technology is often underestimated. The sector is heavily influenced by policy in rich and poor countries (Tait et al., 2006) and in a certain respect by user experience and demand, mostly in rich countries. With reference to the latter for example, there are many examples of drugs being developed for one purpose and then actually proving effectual for entirely different conditions. For example, Sildenafil was originally developed as a treatment for chest pain rather than as treatment for male erectile disorder. In clinical investigations it was found that sildenafil induced unwanted penile erections in some patients instead of relieving chest pain. Pfizer therefore decided to market it for erectile dysfunction and soon became great success with Viagra emerging as a 'blockbuster' drug for the company (Ban, 2006). Treatment targets and regimes are often modified on the basis of feedback from doctors and patients. Science and basic technologies are only a small part of a complex and multifaceted sector.

With reference to the former in developing and developed countries close interaction with policy in some instances and health care policy and systems in others has mattered enormously in shaping the evolution

of firms and technologies (Chataway et al., 2007). The sector is heavily influenced by patent and risk regulation. Some analysts consider that it is regulation which largely lies behind the structure of the industry (Tait et al, 2009). It is a structure which has certainly not helped in serving the needs of low income users and has been extremely controversial because of this. There have been numerous examples where drugs developed by large pharmaceutical firms were unaffordable to poor patients in developing countries. However some policy interventions had an enormous impact on the direction of innovation and making medicines targeted at lower income populations (Simonetti et al., 2007). As we shall now discuss, the case of the Indian pharmaceutical sector points to the significant impact policy and regulation can have in the development of the pharmaceutical industry.

3.1 Policy impact on pharmaceutical industry growth: A brief history of the Indian pharmaceutical industry

One example of the way in which policy and regulation have impacted on the evolution of the sector is provided by the Indian government's decision to intervene to create an industrial apparatus to better serve the needs of its people (Chataway et al, 2007). Shifts in policy and investment encouraged the growth of an industry focused on the needs of low-income users. A new social technology emerged that was closer to these users and better able to address local priorities. It is worth looking in some detail at first, how the Indian pharma story evolved as it does relate closely to the argument that large MNCs in their current form were and perhaps still are unable to address the needs of low income users. Secondly, the rate and direction of innovation in pharma is very far from being determined only by scientific and technological or market factors.

Since the independence in 1947, the Indian government has taken public policy initiatives to encourage public, private as well as foreign investments in pharmaceutical R&D with the ultimate aim of making drugs available to all citizens at affordable prices. The most significant initiative, however, was the policy change to non-recognition of pharmaceutical product patents. The 1970s Patents Act propelled Indian

firms onto a reverse engineering[3] path and laid the foundation for a strong domestic industry. The resulting 'imitative' follower trajectory, facilitated by the lack of intellectual property rights, differed greatly from the technological trajectories followed by firms in the US and Europe (Kale and Little, 2007).

Over the past 50 years, the Indian pharma industry has gone through three periods of development, linked to three different public policy actions, each linked to patent acts. Each period is distinguished from another through the role of government policy and regulatory regimes. During this period policy intervention steered firm level strategies and gradually Indian firms have gone from being weak followers in the 1970s to partners of choice for multinational companies in their drug discovery research and development efforts (Chaturvedi et al., 2007).

In 1970, eight of the top ten firms in the Indian market were MNCs, but by 1995, only four of the top ten firms were MNCs (Athreye et al. 2008). Post 1990 India emerged as a cheap and efficient supplier of bulk drugs and formulations to countries from the developing and developed world. The pharma industry started to really take notice of the Indian pharmaceutical industry's generic and manufacturing capabilities when in 2001 Cipla, one of the largest Indian emerging manufacturers, announced a major price reduction for Triomune, a first-line combination HIV therapy. Cipla offered a person's yearly dose to NGOs for $350, to governments for $600, and $1200 for retail distributors. The impact of Cipla's offer was immediate and significant; alternative AIDS treatment cocktails were selling at $10,000-$15,000 (per patient per year) in the advanced countries at the time. Large pharmaceutical firms threatened to fight Cipla, but due to international pressure, they cut the price of their own drugs - by up to 90 per cent making them also affordable to developing country governments.

[3] Reverse-engineering R&D involves imitating a product by modifying existing process or developing it by using new process**.**

As we can see in this case, regulation and policy change along with the dynamic response of Indian firms made a serious contribution to improving the supply and access of medicine to poor populations in developing countries. However, since the 1990s, the environment has changed again. This time, because of India's obligation under the TRIPS Agreement of WTO, which covers adoption of product patents from 2005, the intellectual property rights (IPRs) framework is in a transitory phase. TRIPs require India to restrict the reverse engineering or independent development of new products patented elsewhere. Keely (2000) reviews the impact of TRIPs on pharmaceuticals and suggests that as long as the TRIPs agreement is in place most developing countries will almost always continue to suffer a decrease in social welfare.

3.2 Plus ca change?

Despite, a few rare examples such as the Indian case study above, there can be little doubt that market constraints play a role in ongoing health inequalities and very slow progress in developing sorely needed treatments and vaccines for low income populations in developing countries. A large literature develops analysis of neglected diseases and neglected patients from this perspective. An influential strand of this writing has argued that advanced market commitments (AMCs) are an important part of the solution to this problem of lack of drug development (Kremer and Glennerster, 2004). A new approach to public health funding; Advance Market Commitments (AMCs), are designed to stimulate the development and manufacture of vaccines specifically for developing countries. As a result GAVI (The Global Alliance for Vaccination and Immunisation) has implemented a pilot AMC scheme for pneumococcal vaccines beginning in 2009.

AMCs and 'pull' mechanisms designed to provide demand incentives for companies to invest in product development are argued either as a complement or alternative to 'push' programs and initiatives. The latter propose to resolve market failure through large government and philanthropic foundation

investment in science, R&D and product development. The logic here is that if market failure means lack of private investment in basic science and R&D, then where compelling social and political reasons exist, the public sector should step in (Archibuigi, 2006).

While pull mechanisms may be necessary, pull or demand based mechanisms do not necessarily signify a link to users and a more low income driven user focus as argued in the previous section. This is important because it is very likely that one thing that hinders pharmaceutical companies in developing products for lower income users is effective distribution and feedback loops or put another way an effective value chain. The link between an individual's health and the innovation and healthcare systems that could contribute to a value chain which would serve the needs of low income users more effectively is lacking in many cases. This in part explains why a powerful Indian pharmaceutical sector does not equate with drastically improved health outcomes for poor Indians (Chaturvedi et al., 2007)

Thus there are good reasons to believe that neither demand pull or supply push will (on their own or in combination) solve the problem. The problem may take longer to resolve as it almost certainly requires new institutional and organisational forms which can address the needs of low income users as their core concerns and it requires new systems and new interactions built on the back of them. There is now a plethora of new institutions and organisations involved in global health and related R&D and product development and a very significant increase in funding available for research in this area. Simply putting additional finance into drug development, whether it is in the form of push or pull mechanisms will not solve the need to create more responsive organisations that have as their key concern the needs of low income users. The question remains whether the new constellation involved in the production of vaccines and other drugs will prove any more successful over the medium and longer term than previous institutional infrastructures.

4. Healthcare needs of low income populations

The past two decades have seen considerable innovation in the spectrum of organisations and institutions involved in global health. There is also some evidence that the geographical shift in capabilities in pharmaceuticals, of which emerging countries such as India and China are a part, is having some effect on who does the work involved in developing new drugs for developing countries' needs and how the work gets done. This section addresses some of the changes that have taken place using a Technology/Market Matrix and analyses some of the evidence that they might be having an impact on drug development for developing country needs.

4.1 A Technology/ Market Matrix

The matrix presented in fig. 1 divides technologies and users into four different quadrants using traditional and new levels of market and technology from the perspective of meeting health needs. The key concerns of this paper fall on the right hand side of the matrix and particularly the issue of who will develop new 'western' medicines for poor consumers identified in the bottom right hand box of the matrix; that is new technologies for new markets.

{Fig. 1 here}

The Traditional Technology/Traditional Market quadrant of the matrix represents conventional treatments for the 'rich' such as heart disease, cancer for consumers mostly in advanced markets while New Technologies/Traditional Market covers the important 10-90 issue whereby most R&D spend goes to develop new drugs for a small percentage of the world's population. It includes trends towards personalised medicine, stem cells and synthetic biology.

The Traditional Technology/New Market quadrant represents generics for neglected diseases, new distribution channels for drugs developed in the West and traditional healthcare in developing countries.

The New technologies/New Market quadrant represents new social and physical technologies; the new mix of technologies, organisations and institutions that are delivering healthcare solutions to poor populations of developing countries. This quadrant also includes indigenous and traditional cures supplied to consumers in developing countries.

Fig. 2 represents three different potential types of actor or solution that have the ability to develop new Western medicines for poor consumers in developing countries (New Technologies/New Markets quadrant); a. large pharmaceutical firms, b. emerging country firms and c. New social technologies. Section 5 below discusses their ability to operate in this quadrant in more details.

{Fig 2 here}

5. Solutions to meeting the new technology needs of low income populations in developing countries

This section discusses contributions to meeting new technology based needs of low income populations in developing countries. We begin by looking at emerging market activities of purely private sector firms both in industrially developed contexts and industrially developing country contexts.

5.1 Large western pharmaceutical firms

In the last two decades large pharma companies on an increasingly frequent basis have offered to provide cheap medicines to the world's poorest countries on a narrow range of medicines - notably anti-retrovirals for HIV. These types of deals and the partnerships that result derive from political pressure, corporate social responsibility and perhaps a sense of needing to do to business in more inclusive ways.

With the growth of the middle class in developing countries there has been a very significant change in large pharma's strategies for emerging markets. Both as producers and consumers of healthcare, emerging markets are now extremely important in the global context. According to an IFC report (2009) the

combined health market in Africa (12 countries), Asia (9), Eastern Europe (5), Latin America and the Caribbean (9) is US $ 158.4 billion accounting for spending of 3.96 billion people. An IMS Health Report (2010) suggests that 17 high-performing emerging nations, amounting to around 16% of the total world market or US$123 billion in 2009, are set to form new growth markets for pharmaceutical industry overturning the established pharmaceutical order.

In response to this MNCs have begun to invest heavily in emerging markets. Large pharmaceutical firms struggling with R&D productivity, pricing pressure in western markets and erosion of profits in generic markets are transforming their business strategies to address fast growing emerging markets. As a result large pharma firms are re-modelling their operations by moving into generics via acquisitions and other deals: e.g. Sanofi-Aventis with Zentiva and Kendrick Farmacêutica, Pfizer's deal with Aurobindo and GSK's deal with Dr. Reddy's laboratories.

GSK reports its strategy as shifting from a traditional blockbuster model and towards driving growth from new products, emerging markets and its consumer business. In 2009 only 30 per cent of GSK's revenue in the quarter was derived from its traditional "white pill/Western markets" business, compared with 38 per cent in the 2008. Adopting a high volume strategy in emerging markets GSK plans to significantly reduce prices of its medicine in emerging economies in 2010. Thus, according to Abbas Hussain, head of emerging markets at the GSK (Financial Times, 2009):

> "My preference is not a high price and 100 units of profit for 100 patients, but to drop the price and make 10 units of profit from 500 patients".

GSK has made several moves to build its presence in emerging regions around the globe. In 2009 GSK signed a deal with Aspen, a South Africa-based pharma company, to commercialize Aspen's portfolio of branded drugs in emerging markets (Aspen manufactures inexpensively, and GSK pays them a percentage of sales). In May 2009, GSK bought 16% of Aspen and sold a number of specialty medicines to the company along with a manufacturing site in Germany. GSK had also sold some brands to Aspen in June

2008. The two companies plan to collaborate on commercializing products in sub-Saharan Africa outside of South Africa. In South Africa, where Aspen has extensive commercial capability, GSK will transfer marketing and distribution rights to Aspen for its pharmaceutical products. Their combined revenue in that region was $122 million in 2008. GSK set up a similar deal in June 2009 with Dr. Reddy's Laboratories (a leading Indian firm), in which GSK will get access to more than 100 branded drugs that it will market in Africa, the Middle East, Asia and Latin America. The drugs cover cardiovascular, diabetes, oncology, gastroenterology and pain management; they'll be manufactured by Dr. Reddy's and revenues will be shared. During the same year, GSK also acquired rights in emerging markets for several products from UCB Pharmaceutical and picked up Bristol-Myers Squibb's Pakistan business and its mature products in Egypt including high quality manufacturing facility in Giza, Greater Cairo. In Egypt GSK will acquire 20 branded products that occupy top market positions in four therapeutic disease areas with combined sale of $48 mn in 2007. Following on that GSK acquired the branded generics business of Bristol Myers Squibb in Lebanon, Jordan, Syria, Libya and Yemen for a cash consideration of $23.2m (£14.2m). The business comprises a portfolio of 13 branded pharmaceuticals with annual sales of $11.8m.in 2008.

Pfizer has adopted a different strategy with a similar aim by extending a licensing agreement with Aurobindo, an Indian firm, in May 2009, acquiring rights to 55 solid oral dose and five sterile injectables in 70 markets. Two months earlier, Pfizer bought from Aurobindo rights to 39 generic solid oral dose products in the U.S. and 20 in Europe, and another 11 in France, as well as rights to 12 sterile injectable products in the U.S. and Europe.

In 2010 Abbott set up a stand-alone Established Products Division (EPD) specifically for expanding the market for Abbott's established pharmaceutical portfolio outside of the U.S., particularly focused on emerging markets. Abbot's EPD division in 2010 entered a licensing and supply agreement with Zydus

Cadila of India for a portfolio of pharmaceutical products that Abbott will commercialize in 15 emerging markets, enabling the company to further accelerate its emerging markets growth.

Thus, large pharma is investing heavily in emerging markets and taking their mainstream technologies and products to new markets as indicated in the top right hand quadrant of the Market/Technology Matrix. But while large pharma is clearly serious about investment in emerging markets, this change must be kept in perspective. Sales figures of the top 20 large pharmaceutical firms' in 2009 show that major markets for these firms are still in the USA, Western Europe and Japan while analysis of their R&D pipeline points out that their R&D investments for the future are still tuned to tap traditional pharmaceutical markets (Table 1).

The point here is large firms probably do not have the incentive or perhaps the organisational and institutional focus to make health problems that are most worrying to developing countries a priority. Frew et al (2009) reporting on the G-Finder survey shows the extent and nature of private sector investment in drug development for developing countries:

> …the private biopharmaceutical industry provided $231.8 million (9.1% of the global total), 80% of which came from multinational drug companies and 20% came from biopharmaceutical small and medium-size firms. Both types of firms reported that the majority of their R&D for neglected diseases went to the "big three" diseases (75% and 82% respectively). The remaining investment from the biopharmaceutical industry primarily went to so-called commercial neglected diseases, such as dengue, pneumonia, meningitis, and the diarrheal diseases, where neglected disease activity can be piggybacked onto activity targeting commercial markets for these diseases. "Low or no commercial" diseases, such as Chagas disease, leishmaniasis, African sleeping sickness, trachoma, and helminth infections, attracted little to no investment by the firms surveyed. It is worth noting that primarily companies from the developed world were included in the G-Finder survey".

{Table 1 here}

According to another IMS report (2010), in 2009, the world's top 15 pharmaceutical manufacturers derived just 0.9% of their combined sales from China and 2.9% from the Tier 2 markets of Brazil, India and Russia; and 5.6% from the Tier 3 markets containing group 12 countries such as Argentina, Turkey and South Africa. In many cases, this reflects a continued focus on the premium section of the market and in core business a lack of exposure and appetite for low income markets. Quite naturally the focus on wealthier users in wealthier countries which was and still is at the core of most large MNCs business organisation was not appropriate for dealing with the very different problems posed by challenges of developing country health care needs.

However as the following section demonstrates, there is evidence that large pharma are collaborating with others to try and engage more effectively with low income users and address the New Technology/New Market needs as identified in the lower right quadrant of the Market-Technology Matrix.

5.2 R&D Collaboration between MNC, emerging country firms and research institutes

Many large firms are now making concerted efforts to work with firms and research institutes from developing countries on diseases which afflict low income populations. They are in effect forming new social technologies to try and develop new technologies and products which respond to a great degree to the needs of low income users. For example, GSK is partnering with firms and research institutes from developing countries to deliver and expand on an ambitious global business model. Examples include GSK's partnership with Fiocruz, a public sector research institute in Brazil, a deal with China's Shenzhen

Neptunus to develop and manufacture flu vaccines and an R&D deal with Indian firm Ranbaxy. Their activities have resulted in GSK being named the industry leader for improving access to medicines.[4]

In 2009 GSK entered into partnership with Fiocruz to develop and manufacture vaccines for public health priorities in Brazil. The agreement established a new research and development collaboration programme at Fiocruz to develop a vaccine for dengue fever. GSK will provide Fiocruz with access to the technology used in its 10-valent pneumococcal conjugate vaccine for paediatric disease and will supply pneumococcal vaccines to Fiocruz until the technology transfer is completed. Unlike in the past this collaboration involves developing a R&D centre that will focus on the development of new vaccines. In the past GSK Biologicals has supplied many vaccines to Fiocruz beginning with Oral polio vaccine in 1985 but only on a simple licensing arrangement, not in this much wider 'partnership' type approach.

Some MNC firms are establishing R&D centres in Indian and China to access to local cheap knowledge resources for their main stream business as detailed above however these centres are also involved in research of neglected diseases. For example, in 2003 Astra- Zeneca established a R&D centre in India dedicated to finding a cure for Tuberculosis and infectious diseases of the developing world. From the beginning of 2005 Novartis has committed major investments in China, including US$1bn on R&D and US $125 million to buy an 85% stake in a privately held vaccine company. Similarly in 2009 Johnson & Johnson started developing an R&D presence in emerging markets like India and China. The company has set up an R&D operation in Mumbai, an R&D headquarters in Shanghai and collaboration with Tianjin Medical University Cancer Hospital, China on biomarker research.

[4] See http://www.accesstomedicineindex.org/ (accessed 17/10/10)

5.2 Firms from emerging economies

If large pharma is unable to incorporate the needs of low income users into its basic business model, what about firms from developing countries? In the post TRIPS era Indian industry has emerged as one of the main producers of cheap generic drugs. Indian firms responded to the regulatory challenge by adopting different combination of strategies such as entering generic markets of advanced countries by using process innovations by offering services to MNC firms and also new drug discovery. While process innovations and service models were based on existing competencies, new drug discovery required new competencies (Kale and Wield, 2008).

The Indian pharma sector achieved an incredible feat in building an industry to challenge the dominance of western MNCs. A David and Goliath story built on imitation and reverse engineering. Having built competences and knowledge capabilities over the years Indian firms now have the internal resources to begin developing new drugs. However, regulation, trade policy and the lack of effective markets make it difficult for firms to devote expensive R&D and drug development to developing country priorities. This argument rests on a perceived market failure. Put simply, as with large pharmaceutical firms in developed countries, high R&D and development costs combined with poor market prospects do not give firms sufficient incentives to invest in new treatments and drugs which will be mainly relevant for developing countries.

Similar to large pharmaceutical firms, Indian firms' generic market strategy and R&D pipeline shows a strong bias towards advance country markets (Table 2). Since 2000 Indian firms have adopted overseas acquisitions as a key strategy to acquire knowledge regarding advance markets, technology and regulatory skills. The value of the Indian pharmaceutical industry's overseas acquisition has grown from just US $8 million in 1997 to $116 million in 2004 (Bloomberg, 2005). Geographically the overseas acquisition by

Indian pharmaceutical firms continues to be directed at developed countries specifically the US and Europe.

{Table 2 here}

Due to financial constraints and lack of capabilities Indian firms started out-licensing their molecules after completion of pre-clinical stage or phase I of the clinical trial process to MNC firms in return for milestone payments. In 1997 DRL out-licensed an anti-diabetic molecule to Novo-Nordisk while in 1999 Ranbaxy achieved a first significant international success by licensing its once-a-day Ciprofloxacin formulation on a worldwide basis to Bayer. It provided both firms with significant revenues and also established a roadmap for other Indian firms. Similar significant examples include deals with Novartis made by DRL and Torrent. While some deals are progressing well they still have not generates sufficient revenue to allow Indian firms to take products to final stages of development.

Acquisition of emerging pharmaceutical firms by MNCs

Another trend observed is the acquisition of emerging country firms by large pharmaceutical firms to set up generic product development and manufacturing facilities (Table 3). In 2009 Ranbaxy was acquired by Japanese firm Daiichi Sankyo to augment Daiichi's generic product portfolio and expand presence in the emerging countries (Financial Times, 2009). Ranbaxy gained more than 80% of its sales from overseas markets and had a presence in 90 countries all over the world. In 2006 Mylan laboratories, a major generic firm acquired leading Indian generic company,Matrix laboratories to improve firm's geographic diversification and develop broader therapeutic portfolio. Before the acquisition Matrix was the world's largest supplier of generic anti-retroviral APIs (active pharmaceutical ingredients) and afterwards Matrix has become world hub of manufacturing for Mylan albeit still with strong focus on anti-retroviral. Another top Indian pharmaceutical firm Piramal Healthcare sold its Healthcare Solution Business to

Abbott Laboratories in 2010 for almost $3.6 million. It helped Abbott in acquiring market leadership in the Indian pharmaceutical market and further accelerated the company's growth in emerging markets.
In 2009 Sanofi- Aventis acquired Medley in Brazil and Kendrick in Mexico to access markets in those regions (Annual report, 2009). These acquisitions reinforced Sanofi-Aventis which gained a 12% market share position as a number one pharmaceutical company in the Latin American market.

{Table 3 here}

These acquisitions of emerging country firms or parts of their business by large MNC firms may point towards a next phase of development for the industry that can potentially limit the role of emerging country firms in general, and Indian firms in particular, as a supplier of cheap and affordable drugs to developing countries.

Whilst both large pharma and firms in emerging economies are engaging with diseases afflicting low income populations in developing countries they are doing so in conjunction with public or not for profit sectors. It is also clear that the pharma sector is undergoing change currently and it is unclear what the current round of mergers and acquisitions will signify for emerging economy firms and for large pharma. This paper is not arguing against a role for the private sector to play in constructing new approaches to engaging with the health needs of low income users in developing countries; however it is questioning whether the private sector alone can provide a durable innovation architecture which will deliver ongoing benefits and engagement over time.

It may be as Frew et al (2009) suggest that biotechnology SMEs in developing countries have substantial and central commercial interest in low income patient needs. Frew et al (2009) studied 78 ‘home-grown’ small to medium sized health biotechnology companies in the emerging economies of Brazil, China, India and South Africa excluding manufacturers and domestic subsidiaries of MNCs. These companies were

innovating in the area of biologics, biopharmaceuticals, diagnostics and related technologies and services apparently targeted to address domestic needs. They report that firms have a collective pipeline of nearly 500 products for more than 100 indications. This pipeline consists of novel and other products but it may be that the majority are adaptations of existing drugs. About half of these have received domestic regulatory approval. Frew et al do not specify whether it is the local SMEs who have sought and gained this approval but even in the case that other parties took the drugs through regulatory procedures, the point is clear that these firms may well constitute a vital part of the 'social technologies' needed to deliver drugs to low income users.

The picture portrayed by this research is of SMEs in emerging economies that view low income user markets as an attractive business proposition and see them as an entry point into international markets. Drugs and technologies in development include diagnostics (some of which might be considered low tech but offer very important new technologies for diagnosis and dedication), vaccines and therapeutics. As noted it may be that SMEs in developing countries do constitute an important element in the range of organisations and institutions involved in developing new physical technology and innovation for low income populations. It is unlikely however that they will be able to develop new drugs from research all the way through to marketing and distribution.

6. New Technologies – New Markets: New Social technologies

The previous sections suggest that the private sector alone is unlikely to move in the direction of providing new technology based health products for the poor. A question arises then as to whether public private partnerships and product development partnerships for neglected diseases and neglected populations can provide the organisational mix and new social technology which will enable the development of physical technology and successful innovation which reaches target low income populations. Public-private product partnerships (PDPs) are relatively recent phenomena but quite a few such partnerships have been working on issues of global health. Public-Private Product Development

Partnerships are defined as “a project or portfolio of projects in which public or philanthropic funds and resources are combined to discover and/or develop a product (medicine, vaccine, diagnostics) to meet a public health need” (Ziemba, 2005:,10).

6.1 New technologies in development of products: Product Development Partnerships (PDPs)

PDPs have been set up to develop new products for neglected diseases. A host of new PDPs have emerged, largely funded by charitable foundations and the public sector, over the past 15 years. Several studies have shown that they offer advantages over the private sector or public sector when they act alone (Moran et al., 2005). PDPs are a complex mix of NGO, private and public sector organisations and at best they work to maximise each others’ contribution. Table 4 presents list of PDPs involving large pharmaceutical firms and their outcomes. All those PDPs covered in Table 4 have a large pharma firms along with either local NGO/institute/university working in developing countries, WHO or charity foundations such as Gates Foundation as a key partners. These PDPs cover a wide spectrum of health care needs from anti-malarial drugs to insecticide kits for nets. This section discusses two examples of such PDPs in detail and elaborates on the way in which they work.

{Table 4 Here}

PATH and Intercell, AG partnership for Pneumococcal vaccine

Pneumococcal diseases caused by infection with streptococcus pneumoniae are responsible for the death of 1.6 million people every year. Several pneumococcal vaccines are already on the market albeit with high cost and limited protection; they do protect against all strains of the bacteria.

PATH, an international non-profit organisation established a partnership with Intercell AG, an Austrian biotechnology firm to develop a vaccine containing proteins that are common to all Pneumococcus serotypes that could provide better protection to children worldwide.

The partnership agreement between PATH and Intercell covers preclinical development through phase II clinical trials. It includes draft guidelines for a commercialisation agreement to be negotiated before the start of phase III studies and includes specific commitments on price and supply of the vaccine for public-sector markets in low income markets.

In this partnership each organisation brings complementary expertise to the project as well as a share in the development cost. Intercell's efforts are focused on discovery and preclinical development while PATH provides expertise in clinical trials, manufacturing and vaccine introduction in low income countries. Funding from PATH has covered almost half of preclinical development expenses. This funding helped reduce risk for Intercell and paved expansion of the target market to include children in low-income countries. Intercell's initial aim was to develop a vaccine for elderly people in Europe and USA. Successful preclinical development from 2006 through 2008 has paved the way for a phase I clinical trial in health adults beginning in early 2009.

Medicines for Malaria Venture and Ranbaxy

MMV was officially launched on 3 November 1999 as a non-profit foundation dedicated to reducing the burden of malaria in disease endemic countries by discovering new affordable anti-malarials through effective public-private partnership. MMV in its three years of operation is managing a portfolio of over 14 projects in different stages of Drug Research and Development.

In 2003 Ranbaxy as a part of Medicine for Malaria Venture took over a project for a key new anti-malarial drug from leading research-based healthcare company Roche for further development. Initially Roche worked with the MMV project to develop this new drug, and then passed it onto Ranbaxy to bring it to the market with the continued support of MMV. In 2009 Ranbaxy Laboratories Limited (Ranbaxy) started Phase-III clinical trials for its new Anti-malaria combination drug, Arterolane maleate +

Piperaquine phosphate in India, Bangladesh and Thailand. The drug is targeted at patients in developing countries with the aim of significantly improving upon the conventional options available for the treatment of P. falciparum malaria.

The project being worked on is a new version of Artemisinin, the first new anti-malarial drug to be released in decades. Arterolane maleate + Piperaquine phosphate is a synthetic drug and hence easier to manufacture with better predictability and reliability of supplies. The drug is being developed as a once-a-day therapy for three days and will improve patient compliance, besides being safe and efficacious. One of the main available therapies requires an adult to consume 24 tablets over three days whereas Arterolane maleate + Piperaquine phosphate dosage is 1 tablet per day for three days, thereby resulting in lesser pill burden for the patients and reduced cost.

The original discovery team for this innovative molecule comprised leading scientists from the University of Nebraska Medical Centre, Monash University and the Swiss Tropical Institute with active participation and support of Roche, working on the MMV's partnership model.

Ranbaxy's R&D strengths in process chemistry, formulation development and other preclinical expertise, strong regulatory submission capabilities and cost effectiveness were the key considerations for MMV to partner with the company. Ranbaxy's presence in several African countries will help in delivery of needed medicine to the disease endemic countries, at affordable cost, once testing is complete.

This collaboration also provided Ranbaxy an opportunity to work with leading scientists working in Anti-Malaria and create a better portfolio in this segment of the market. Ranbaxy aims to market the drug in malaria endemic geographies of India, Africa, Latin America and the Asia Pacific.

6.2 Key Characteristics of PDPs as social technologies

One way of looking at PDPs is that they operate as development and innovation actors and work through global networks in both areas. It is the combination of these two sets of activities around concrete product development agendas which is, in part at least, why PDPs have attracted widespread support and have secured financial resource; PDPs bring together a range of actors in public, private and NGO sectors with a targeted mission of introducing, developing and making accessible new technologies and treatments to those who need them in poor countries. Their efforts have had to include support for new science, technology and product development and a range of brokering and capacity building activities around defined product development activities including clinical trials.

This is PDP's social technology innovation and this is why PDPs are widely considered appropriate vehicles for the development new physical technologies. Other public, private and charity organisations can undertake activities in discrete bits of the value chain and have specific capabilities but PDPs introduced a coherent organisational, management and cultural approach to bringing together innovation and development under one organisational banner in a targeted way that moved things forward more rapidly than the alternatives (Moran et al, 2005).

PDPs may share characteristics but they are not of course identical. For example the International AIDS Vaccine Initiative (IAVI) and the Malaria Vaccine Initiative (MVI) are similar in overall goal and mission: both are PDPs aiming to develop and make accessible to poor people in developing countries vaccines for major neglected diseases (Chataway et al., 2010) However, IAVI is at a different stage of product development than MVI which has a product in stage III clinical trials. MVI activities are now increasingly concerned with establishing the distribution and clinical networks needed to make a malaria vaccine available to those who need it should the trials prove successful. It is using its extensive development networks in this work and drawing extensively on its expertise as a 'development broker' to bring key organisations together in order to create a system that achieves the goal of widespread

distribution. IAVI is in some respects moving in the other direction, revisiting the basic science and drawing science and R&D skills around particular agendas. It is drawing on innovation integrator skills. Table 3 provides more examples of not for profit PDPs and classifies them according to characteristics as development brokers or innovator integrators.

6.3 Using PDP social technology for serving the needs of poor

An analogous and useful way of looking at the roles of PDPs can be taken from work by Gardner et al., (2007) who argue that improving access to essential products and services requires three forms of innovation: technological, social and adaptive. Adaptive means "involving both providers and communities to contextualise the adoption of goods and services to local settings" (Gardner et al, 2007).

Adaptation is not a passive phenomenon but requires active interaction and communication between those who produce and those who use products and technologies. This adaptation can be around modification of physical technology (feedback and knowledge from local consumers which help improve the recipe) or in social technology (new ways of dividing and conducting work which can facilitate the development and the distribution of technologies).

Many PDPs, including MVI and IAVI are in a good position to learn about local contexts and innovate in the area of social technologies on the basis of local knowledge. This social technology will be invaluable in devising plans for the production, distribution, acceptance and use of new treatments and drugs. It is clear from many studies that have been carried out that vaccines and other drugs are at times rejected because not enough resource is devoted to understanding local contexts (Leach and Fairhead, 2007). Moreover, the structure of local distribution channels impacts significantly on the way drugs and treatments are consumed (Mackintosh and Mujinja, 2008). By using their connections and networks which span local contexts and global product development, PPPs and PDPs can hopefully give rise to further social technology innovations which will contribute to making new products and technologies

more accessible. For example in 2009 Pfizer established partnership with Grameen Bank to assess the needs of patients, community health care workers and others in Bangladesh. Based on that assessment, Pfizer and Grameen are setting up action plant to meet the most urgent unmet needs of poor customers (Annual report, 2009).

PDPs can also use their distinctive networks, ethos and orientation to input into physical technology development. As mentioned previously it is now widely accepted that most innovation is relatively non-linear with many feedback loops between different stages of product development. Most companies now innovate on the basis of this analysis and have ongoing communication with their users and consumers. They know their customer base and innovate accordingly.

This more user led innovation process involving poorer consumers in developing countries focuses on the demand side of innovation (issues of access and affordability) and not just supply. It involves a range of unseen activities in the setting up of durable innovation infrastructure which has low income users as a central focus and thus has the potential for productive innovation over the longer term for poor users and consumers. This type of activity is difficult for large Western companies or perhaps the powerful pharmaceutical players in emerging economies to undertake due to the path dependency and business trajectories discussed in earlier sections of this paper. The evidence seems to suggest that a mix of public, private and not for profit actors.

Feedback and adaptation requires competence and capability building. PDPs themselves have to acquire the capabilities which will let them absorb local knowledge. When working in poorer developing countries they will often also need to contribute to local capacities and capabilities. A number of PDPs have impressive records in building new scientific, technological and management capacity in developing countries (Chataway et al, 2007 and Chataway et al, 2009).

7. Conclusion

Firms in many sectors have become more demand driven and more engaged in various ways with the users of their products. This has resulted in overall improvement of products and services but it means that individual firms and the value chains associated with them become 'locked-in' to a particular customer based. This customer base is overwhelmingly rooted in wealthier industrialised countries or in the wealthier segments of emerging economies. Work by Prahalad suggests that this 'lock-in' can be broken when large multi-nationals are awakened to the potential revenues from people living on low incomes.

Although pharmaceutical firms are influenced more by basic R&D than firms in many other sectors and tend to be characterised as 'supply driven', they are also subject to the constraints imposed by focusing on a particular and wealthier customer or patient base. This paper argues that a new mix of organisations, rather than large pharma or even pharma companies based in emerging economies is needed to address the health needs of the poor. These new social technologies with an expanded list of stakeholders are perhaps better equipped to engage in a greater degree of value chain and systems building around the needs of low income users.

Large numbers of people from developing countries are living in absolute poverty and with varied and severe unmet health needs. In recent years this population has been viewed as a US $ 5 trillion bottom of pyramid consumer market and various business managers from large MNC firms as well as emerging country firms are devising various product and process strategies to reach this potentially significant market. However, this paper has argued that MNCs are more likely to engage with a range of other stakeholders to undertake this work rather than reorient their core business models.

Some large pharmaceutical firms are focusing more on the emerging country markets and adjusting their products and their costs to suit to consumers in these countries. However involvement of large

pharmaceutical firms becomes viable and fruitful only when a certain level commercial viability is reached. In the last decade emerging countries' pharmaceutical firms have contributed to the reduction of drug prices but with the current strengthening of regulation are mainly targeting the development of products for advanced markets. Emergence of user-driven innovation in firms and demand driven strategies often results in development of innovative products however it also results in firms getting locked-in to a specific customer base.

Thus this paper argues that whilst large pharma and the private sector more generally will be important partners and providers of drugs for wealthier segments of the population in developing countries, they will have a limited role in satisfying healthcare needs of poor populations. Meeting the needs of lower income populations will more likely be met by new mixes of organisations and networks that contain public and private actors. Some of these strategies include participation in new social technologies better connected to local contexts and firms and are in form of not for profit PPPs and PDPs.

This paper uses a Technology-Market matrix to explore the contribution being made by not for profit PPPs and PDPs to meeting the health needs of low income people in poor countries. The paper gives particular attention to PDPs and describes how some PDPs bring together a range of actors in public, private and NGO sectors with the aim of making accessible new technologies and treatments to patients in poor countries. Unlike other arrangements PDPs introduce a coherent organisational, management and cultural approach to bringing together development and innovation. It further reveals that some PDPs at least are able to learn about local contexts and innovate on the basis of local knowledge and this allows PDPs to play an invaluable role in devising plans for the production, distribution, acceptance and use of new treatments and drugs. By using their connections and networks which span local contexts and global product development, PDPs have shown potential to promote social technology innovations that can contribute to making new products and technologies more accessible.

Analysis presented in this paper shows that the emergence of new social technologies, such as PDPs may respond to low income users in developing countries more effectively than the traditional private sector or public sector actors. It reveals that new social technologies with an expanded list of stakeholders are perhaps better equipped in to engage in a greater degree of value chain and systems building around the needs of low income users. In particular, this research highlights the importance of keeping track of, and the potential opportunity created by, the partnership activities of large pharmaceutical firms whether based in India, North America or Europe. Our research on PDPs shows that such activities can result in creative ways to refocus marketing and production activities towards the needs of the poor.

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Figure and Tables

Fig 1 Technology v/s Market Matrix

		Markets	
		Traditional	**New**
Technology	**Traditional**	**Old treatments for 'rich' consumers mainly in West.** **Heart Disease, Cancer are some of the major targets.** **Indigenous and traditional cures supplied to their traditional consumers in developing countries**	**Generics for neglected and diseases** **New distribution channels for old Western developed drugs and indigenous and traditional healthcare in developing countries**
	New	**The 90/10 issue – most R&D spend going to developing new drugs for a small minority of the world's population.** **Includes trends toward pharmacogenomics, personalised medicine and new developments in synthetic biology, stem cells.**	**New Western medicines for poor consumers in developing countries – for example, vaccines for neglected diseases.** **Mix of 'indigenous and traditional medicines and new consumers/users of those products**

Fig 2 New markets: where will solutions come from?

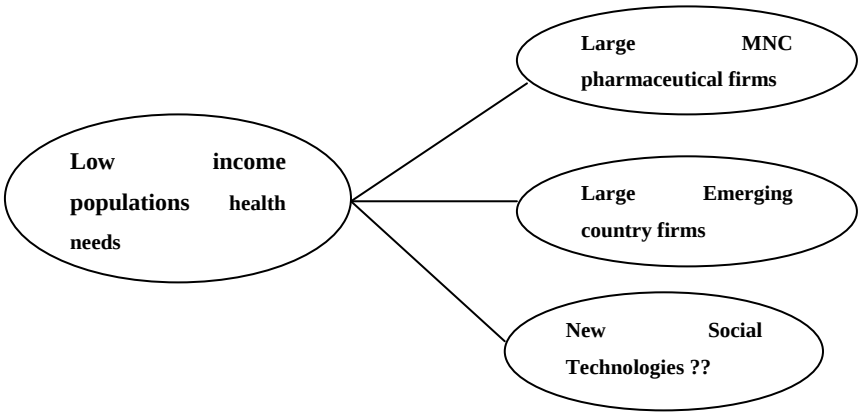

Table 1 Top 15 Global Pharmaceutical Companies in 2009 (Source: IMS Health Midas, December 2009, Annual Reports, 2009)

Rank	Company	Sales ($ US Mn)	Sales from emerging countries %	Total R&D (US $ Mn)	R&D
01	**Pfizer**	**57024**	**14.2**	**7845**	Cardiovascular/metabolic/oncology/respiratory diseases/Neuroscience/infection
02	**Merck**	**38963**		**4805**	cardiovascular, Diabetes and obesity/ infectious diseases /Respiratory & inflammation/ophthalmology
03	**Novartis**	**38460**	**8.9**	**7217**	cardiovascular/metabolic conditions, oncology and neuroscience, respiratory and infectious diseases
04	**Sanofi-Aventis**	**35524**	**~22**	**6731**	Oncology, Cardiovascular/metabolic/ and Vaccines
05	**GSK**	**34973**	**10**	**6599**	Immuno-Inflammation, Neuroscience, Metabolic Pathways, Oncology, Respiratory, Infectious Disease, Ophthalmology and Biopharmaceuticals
06	**AstraZeneca**	**34434**	**13**	**5179**	cardiovascular/metabolic conditions, Respiratory & inflammation, Neuro science/Oncology
07	**Roche**	**32763**	**11**	**8194**	Oncology, Central nervous system, virology, ophthalmology, inflammation, metabolic diseases

08	**Johnson & Johnson**	**26783**	**~16**	**6986**	Nutritionals, medical devices, Pain/Bone, Neuroscience, anti-diabetic, virology
09	**Eli Lilly**	**20310**	**~10**	**4326.5**	Oncology, Central nervous system, virology, inflammation, metabolic diseases, Endicronology, diabetes,
10	**Abbott Laboratories**	**19840**	**~20**	**2255**	Cardiovascular, auto immune disorder, Obesity, virology,
11	**Teva**	**15947**	**14.6**	**802**	Neurologicals, Neurogenerative diseases, Oncology, Autoimmune, inflammatory diseases
12	**Bayer Schering**	**15711**		**2266**	Oncology, Cardiovascular, Alzheimer
13	**Boehringer Ingelheim**	**15725**	**~20**	**2215**	Respiratory diseases, Cardiometabolic diseases, Oncology, Neurological diseases, Immunology, Infectious diseases
14	**Amgen**	**15038**		**2739**	Oncology, metabolic disorder, endocrine, immune deficiency
15	**Takeda**	**14352**	**1.9**	**2690**	Life style-related diseases, Oncology & Urological, Central nervous system, Gastroenterological diseases

Table 2 Leading Indian pharmaceutical Firms (Annual Reports, 2008)

Firm	**Total Sales (Rs. Million, 2008)**	**% from Overseas markets**	**Overseas acquisitions (post 2000)**	**Out-licensing deals**	**R&D focus areas**
Ranbaxy	44814	82	11	2	Anti-infectives, CNS, Gastro-intenstinals, Anti-Malarial, Cardiovascular, Oncology
DRL	69440	67	4	2	Anti-infectives, CNS, Cardiovascular, Oncology, dermatology
Wockhardt	15454	73	8		Vaccines, Anti-infectives, Cardiovascular, Oncology
PIH*	32811	~ 40	5		Ophthalmology, oncology, cardiovascular, anti-infectives
Glenmark	21160	~ 60	5	2	Cardiovascular, CNS,
Cipla	44290	55			Anti-retroviral, Cardiology, Neurology, Oncology, Anti-TB, Anti Malarial
Aurobindo	23,511	60	3		Cardiovascular, Gastro-intestinal, Anti-retroviral, Neuroscience Anti-infectice, Pain management, Osteoporosis
Sun	34606	55	10		CNS, anti-infectives,
Torrent	9959	24	2	1	Respiratory, Cardiovascular, Oncology, CNS, Anti-Infectives, Gastro
Lupin	27730	65	4		CNS, Cardiovascular, Oncology, Anti-Infectives, Gastro

*** Piramal Healthcare formerly knows as Nicholas Piramal (I) Ltd**

Table 3 Large pharmaceutical firm's acquisitions deals in emerging markets (Source: Annual Reports, 2009)

	Large MNC firms	**Emerging country firms**	**Year**	**Deal type**
1	Mylan Labs	Matrix Laboratories (India)	2006	Company Acquisition
2	Daichi Sankyo	Ranbaxy Laboratories (India)	2008	Company Acquisition
3	Frensenius Kabi	Dabur pharma (India)	2008	Company acquisition
4	Hospira	Orchid Chemicals (India)	2009	Injectable business
5	Sanofi-Aventis	Shanta Biotech (India)	2009	Company Acquisition
6	Sanofi-Aventis	Medley (Brazil)	2009	Company Acquisition
7	Sanofi-Aventis	Kendrick (Mexico)	2009	Company Acquisition
8	Perrigo	Vedant Drugs and pharmaceuticals (India)	2009	Company acquisition
9	Mylan Labs	Famy Care (India)	2009	15% stake
10	GSK	Aspen Laboratories (South Africa)	2009	16% stake
11	Sanofi_Aventis	Zentiva NV (Czech Republic)	2009	Company acquisition
12	Abbot Laboratories	Piramal Healthcare Ltd (India)	2010	Formulation business with one manufacturing unit
13	Abbott Laboratories	Wockhardt (India)	2010	Sale of nutritional brands
14	Vetoquinol	Wockhardt (India)	2010	Animal Health division

Table 4 PDPs involving large pharmaceutical firms

No	PDP name	MNC firm	Date of starting	Purpose	Outcome
1	Action TB Programme (ATBP)	GSK	2003	Tuberculosis drug targets	Identified new targets for TB drugs
2	Dengue Vaccine Project (DVP)	Aventis-Pasteur	1989	Dengue vaccine	On going
3	Diflucan Partnership Program	Pfizer	2000	Cure for Fungal infections in HIV/AIDS patients	Distributed more than 3 million doses
4	Eli-Lily multi Drug Resistant Tuberculosis Partnership (MDR-TB)	Eli-Lily	2003	To train personnel and develop TB drugs	On-going
5	GSK African Malaria Partnership	GSK	2002	To promote Malaria control behavioral development	On-going
6	Global Alliance for the elimination of Lymphatic Filariasis	GSK, Merck	2000	Provided access to drugs for treatment of elephantitis	Reached 300 million people by 2005
7	Global Alliance to Eliminate Leprosy	Novartis	1999	Eradicate Leprosy	By 2002 more than 12 million cases were treated and increasing no. of countries are using multi-drug therapy
8	Gloan Guinea Worm Eradication Program (GWEP)	2000	Dupont/American Cynamid	Eradicate Guinea worm by promoting water nets	On-going

			(BASF)/Johnson & Johnson		
9	Global public-private partnership for Hand Washing with Soap (GPHW)	1998	Colgate-Palmolive	Reduction in diarroheal diseases by promoting use of hand washing soap	Many local partnerships ensured success in India and Ghana
10	Infectious Disease Research Institute (IDRI)	1994	Corixa corporation	Treatment for Leishmaniasis	On-going
11	International Trachoma Initiative (ITI)	1998	Pfizer	Improve access of drugs for Trachoma (blindness)	Acute diseases in children from Tanzania, Ghana and Vietnam were reduced
12	Malarone Donation Program	1997	GSK	Preserve utility of Malarone as anti-malarial agent	Ongoing
13	Global elimination of Maternal and Neonatal Tetanus	1998	Becton Dickinson & company	Reduce Tetanus infections in women and children	33 million women protected since 1999
14	Mectizan Donation Program	1987	Merck	Eradicate River blindness	250 million doses were donated to more than 30 million people in 34 countries
15	Net Mark Plus	1999	BASF/Bayer AG	Malaria	Targeted malaria through insecticide kits

					for nets
16	Secure the Future	1999	Bristol-Myers Squibb	Provide care and support for women and kids with HIV-AIDs	Over 150 projects have been funded in South Africa, Botswana, Namibia, Lesotho and Swaziland
17	Step Forward Programme	2000	Abbott Laboratories	Provides support to children affected by AIDs	On-going
18	WHO Programme to Eliminate Sleeping Sickness (WPESS)	2001	Aventis SA and Bayer AG/ Bristol-Myers Squibb	African trypanosomiasis	On-going
19	WHO/Novartis Coartem	2001	Novartis	Malaria drugs	On-going
20	LAPDAP Anti-Malarial Drugs	2003	GSK	Malaria drugs	Drug under Phase IV studies